REMARKS

This is a full and timely response to the final Office Action mailed March 6, 2007, in which each of Applicants' Claims 1-21 was rejected. This response is submitted in conjunction with a request for continued examination (RCE). By way of this Response, independent Claims 1, 3-6, 13, and 17 have been amended; and Claim 2 has been cancelled. Reconsideration of pending Claims 1 and 3-21 is respectfully requested in view of the following remarks.

I. Telephone Conversation with Examiner on May 23, 2007

Applicants are grateful to Examiner Smith for engaging in a telephone conversation on May 23, 2007, regarding the patentability of Applicants' claims in view of the rejections set-forth in the final Office Action mailed March 6, 2007. At the conclusion of this discussion, it was agreed that a declaration explaining why it would not have been obvious to one of ordinary skill in the art at the time of the invention to planarize a work piece utilizing a single soft polishing pad would be looked upon favorably as evidence supporting the allowance of those claims reciting such a step (i.e., a step of planarizing a workpiece utilizing a single soft polishing pad). Applicants have submitted such a declaration herewith.

II. Rejection of Applicants' Independent Claims 1, 13, and 17 under 35 U.S.C. § 103

On page 2, the Office Action rejects Applicants' independent Claims 1 and 17 under 35 U.S.C. § 103(a) as being unpatentable over Ueno (US Pat No. 6,245,676) in view of Saka et al. (US Pat No. 6,476,921). In asserting this rejection, the Office Action states that the Ueno reference teaches each of the claimed steps with the exception of removing the copper and barrier layer with a single polishing pad. The Office Action contends that such a step is taught by the Saka reference and, therefore, that it would have been obvious to one of ordinary skill in the art to modify the CMP method of the Ueno reference to produce Applicants' claimed planarization method for the purpose of reducing the equipment needed to perform CMP.

On page 2, the Office Action further rejects Applicants' independent Claim 13 under 35 U.S.C. § 103(a) as being unpatentable over the Ueno and Saka references in view of Hsu et al. (US Pub. 2003/0040188). Although recognizing that neither the Ueno nor the Saka

reference shows or describes the use of a soft polishing pad, the Office Action states that the Hsu reference teaches the utilization of a soft polishing pad as conventional in CMP processes. The Office Action concludes that "it would have been obvious to one of ordinary skill in the art at the time of the invention to use the soft polishing pad of Hsu et al. in Ueno in view of Saka et al.'s process as such practice is conventional in the [CMP] arts."

Applicants independent Claim 1 has been amended to further distinguish over the cited references. After amendment, Applicants' independent Claim 1 recites a method for planarizing a semiconductor wafer, which includes the following steps:

(1) electrodepositing a layer comprising copper having a substantially planar upper surface overlying the barrier layer and filling the features in the insulating layer; and

(2) polishing the layer comprising copper and the barrier layer on a single *soft* polishing pad to remove the layer comprising copper and the barrier layer from the field region *and produce a substantially planar surface*. (Emphasis Added)

As reflected in the foregoing Listing of Claims, Applicants' independent Claims 13 and 17 have also been amended and now recite steps similar to those recited in Applicants' amended independent Claim 1. Support for these amendments may be found in Applicants' FIGs. 1-3 and the attendant description (e.g., Paragraphs 0016, 0022, and 0023). Please note that the term "substantially planar surface" is defined in Applicants' Paragraph 0016 as "a surface having no step height greater than about 100 nm."

As explained below, the references of record fail to teach or suggest the step of electrodepositing a copper layer having a substantially planar upper surface and the step of polishing a copper layer and a barrier layer on a single soft polishing pad to produce a substantially planar surface as is now recited in each of Applicants' amended independent Claims 1, 13, and 17.

(1) The cited references fail to teach the step of electrodepositing a copper layer having a substantially planar upper surface

On page 2, the Office Action asserts that the Ueno reference teaches the step of "electrodepositing a layer comprising copper having a substantially planar upper surface," and directs attention to Column 1, Lines 55-59 and FIG. 1(c) of the Ueno reference (in particular, illustrated copper plated layer 37a). However, contrary to the assertions of the Office Action, copper plated layer 37a does not have "a substantially planar upper surface," as that term is defined in Applicants' application. As evidentiary support for this statement, please find submitted herewith a Declaration signed by Vishwas Hardikar, an inventor of the instant application. As indicated by his educational background and work experience (please see items 1-3 of the Declaration), Mr. Hardikar may be considered one of ordinary skill in the art of semiconductor fabrication. Mr. Hardikar has reviewed and understands the Ueno reference (please see item 4 of the Declaration). As Mr. Hardikar attests, the electroplating method utilized to form copper plated layer 37a shown in Ueno FIG. 1(c) and described in the attendant description yields an overburden including an upper surface having a step height well beyond 100 nanometers (please see item 8 of the Declaration). Therefore, copper played layer 37a does not have "a substantially planar upper surface," as that term is defined in Applicants' Paragraph 0016

In view of the above, it should be appreciated that the Ueno reference fails to teach the step of electrodepositing a layer comprising copper *that has a substantially planar upper surface* as recited in Applicants' amended independent Claims 1, 13, and 17. The remaining references of record likewise fail to teach such an electrodeposition step and, consequently, cannot be relied upon to cure the deficiencies of the Ueno reference.

(2) The cited references fail to teach the step of polishing a copper layer and a barrier layer on a single soft polishing pad to produce a substantially planar surface; nor would it have been obvious to one of ordinary skill in the art at the time of the invention to utilize a single soft polishing pad to planarize a workpiece in the claimed manner.

As noted above, the Office Action contends that it would have been obvious to one of ordinary skill in the art at the time of the invention to use the soft polishing pad disclosed in the Hsu reference in conjunction with the CMP method disclosed in the Ueno and Saka references. In a previously-submitted Amendment (received by the Mail Room on January 4, 2007), Applicants disagreed with this contention and explained that one skilled in the art would not have recognized a reasonable expectation of success in utilizing a single soft polishing pad to remove the copper layer and the barrier layer because, at the time of Applicants' invention, it was commonly believed that at least one hard polishing pad was necessary to achieve a substantially planar surface. In support of this statement, Applicants cited Applicants' Paragraph 0023, which states, in relevant part:

> *Although hard polishing pads have in the past been thought necessary to achieve a substantially planar surface when performing a CMP process on an electroplated copper layer, the present inventors have discovered that such hard polishing pads are not necessary to achieve the desired substantially planar surface when the copper layer to be polished and planarized initially has a substantially planar upper surface and does not have a thick overburden overlying the filed regions of the dielectric layer.*

After filing the previously-submitted Amendment, Applicants received a final Office Action (i.e., the outstanding Office Action mailed October 11, 2006) stating that Applicants' argument was found unpersuasive. Specifically, on page 4, the final Office Action states that Applicants provided only conclusion statements (not evidence) about the expected success (or lack thereof) in employing a single soft polishing pad to produce a substantially planar surface.

On May 23, 2007, Applicants' representative engaged in a telephone conversation with Examiner Smith regarding this rejection. At the conclusion of this conversation, it was

agreed that the provision of a declaration explaining why it would not have been obvious to one of ordinary skill in the art at the time of the invention to planarize a work piece utilizing a single soft polishing pad would be looked upon favorably as evidence supporting the allowance of those claims reciting such a step (i.e., a step of planarizing a workpiece utilizing a single soft polishing pad).

Per the above-referenced conversation, a Declaration has been submitted herewith signed by Vishwas Hardikar, an inventor of the instant application. As indicated by his educational background and work experience (please see items 1-3 of the Declaration), Mr. Hardikar may be considered one of ordinary skill in the art of semiconductor fabrication. In the Declaration, Mr. Hardikar attests to the following statement (please see items 5-8 of the Declaration):

> *At the time of the invention claimed in the instant application, electroplating techniques conventionally employed in the semiconductor industry produced a relatively thick overburden (i.e., having a thickness well beyond 300 nanometers) including a substantially non-planar upper surface (i.e., having a step height well beyond 100 nanometers). Soft polishing pads generally conform to a non-planar upper surface and, thus, remove material at a substantially constant rate across the upper surface. Soft polishing pads were consequently considered generally inadequate for planarizing a workpiece having an overburden including a substantially non-planar upper surface of the type produced by conventional electroplating techniques. In contrast to soft polishing pads, hard polishing pads do not generally conform to a non-planar upper surface and, thus, remove material at different rates across the upper surface to thereby smooth out topographical irregularities. For at least this reason, it was conventional practice in the semiconductor industry at the time of the invention to utilize at least one hard polishing pad to planarize an electroplated workpiece.*

Thus, as evidenced by the statements set-forth in the accompanying Declaration, it would not have been to obvious to one of ordinary skill in the art at the time of the invention to perform the step of planarizing (or polishing to produce a substantially planar surface) an electrodeposited copper layer and a barrier layer utilizing *a single soft polishing pad* in the manner recited in Applicants' amended independent Claims 1, 13, and 17.

It is well-known that the prior art reference(s) must teach or suggest all of the claimed limitations before a *prima facie* conclusion of obviousness may be established under 35 U.S.C. § 103(a). MPEP § 2142. Considering the foregoing, it should be appreciated that the

cited references fail to teach or suggest at least two steps recited in each of Applicants' amendment independent Claims 1, 13, and 17. Therefore, Applicants respectfully submit that the Applicants' amended independent Claims 1, 13, and 17 are patentably distinct over the cited references under 35 U.S.C. § 103(a).

As no further rejections have been asserted against Applicants' independent Claims 1, 13, and 17, Applicants respectfully submit that Claims 1, 13, and 17 are allowable.

III. Rejection of Applicants' Dependent Claims 2-12, 14-16, and 18-21 under 35 U.S.C. § 103

On page 2, the Office Action rejects Applicants' dependent Claims 7-8 under 35 U.S.C. § 103(a) as being unpatentable over the Ueno reference in view of the Saka reference. Also on page 2, the Office Action rejects Applicants' dependent Claims 2-3, 9-11, 14, 16, and 18-21 under 35 U.S.C. § 103(a) as being unpatentable over the Ueno and Saka references in view of the Hsu reference. Next, on page 3, the Office Action rejects Applicants' dependent Claim 4 under 35 U.S.C. § 103(a) as being unpatentable over the Ueno and Saka references in view of the Hsu reference and in further view of Sinha et al. (US Pat. No. 6,551,935). Lastly, on page 3, the Office Action rejects Applicants' dependent Claims 4-6 and 15 under 35 U.S.C. § 103(a) as being unpatentable over the Ueno and Saka references in view of the Hsu reference and in further view of Mahulikar et al. (US Pat. No. 6,776,696).

Applicants' dependent Claims 3-12, 14-16, and 18-21 are believed to properly depend from Applicants' independent Claims 1, 13, and 17, respectively, and are consequently believed allowable therewith.

Applicants' dependent Claim 2 has been cancelled without prejudice or disclaimer of the subject matter contained therein. Dependent Claims 3-6, which previously depended from dependent Claim 2, have been amended to depend directly from Applicants' amended independent Claim 1.

IV. Conclusion

In view of Applicants' forgoing amendments and remarks, it is respectfully submitted that the rejections set-forth in the final Office Action dated March 6, 2007, have been

overcome. Accordingly, Applicants respectfully submit that the Application is now in condition for allowance, and such allowance is earnestly requested. Should the Examiner have any questions or wish to further discuss this application, Applicants request that the Examiner contact the Applicants' attorneys at (480) 385-5060. If for some reason Applicants have not requested a sufficient extension and/or has not paid a sufficient fee for this Response and/or for the extension necessary to prevent abandonment on this application, please consider this as a request for an extension for the required time period and/or authorization to charge Deposit Account No. 50-2091 for any fee which may be due.

Respectfully submitted,

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